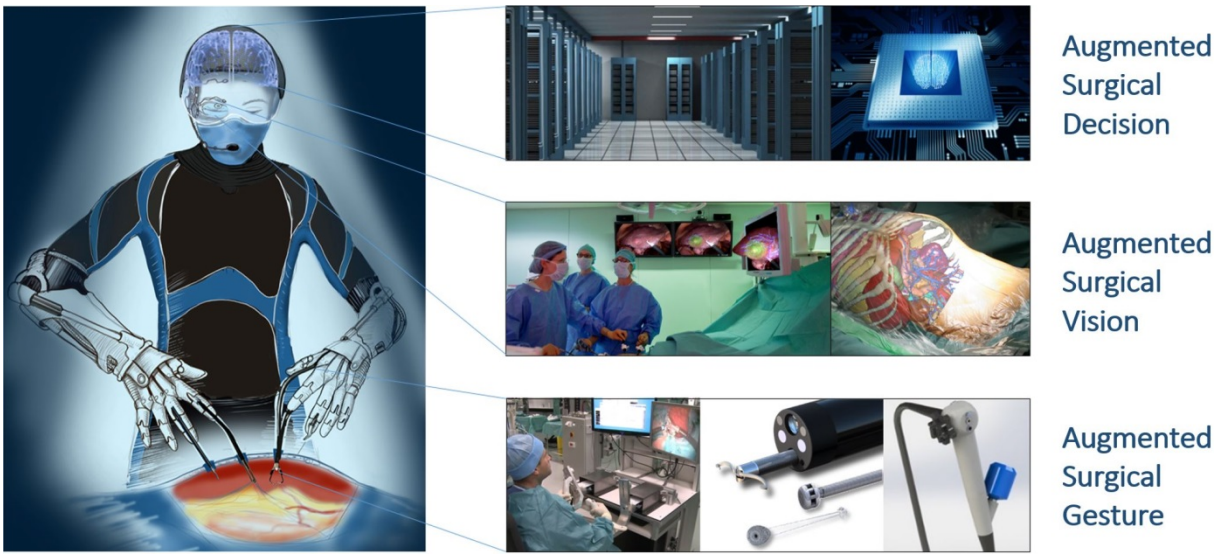
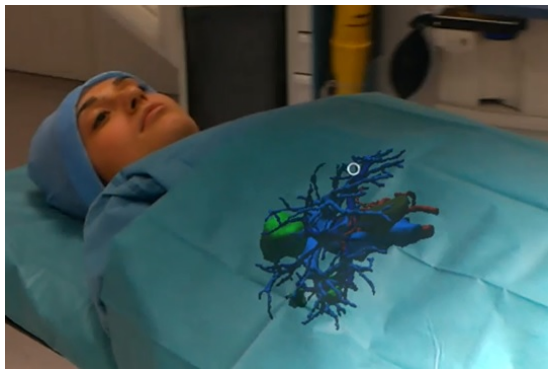
Computer assisted Minimally invasive Hybrid Surgery

Luc Soler, Didier Mutter, Jacques Marescaux
IRCAD-Strasbourg IHU, 1 place de l'hôpital, 67091 Strasbourg

A new surgery area is rising: the Augmented Surgery. Indeed, over the last years, several new computer-assisted surgery technologies have been developed in order to improve surgeon ability and increase safety. These technologies augment surgeon vision, surgeon gesture and surgeon decision, introducing the Augmented Surgery concept.

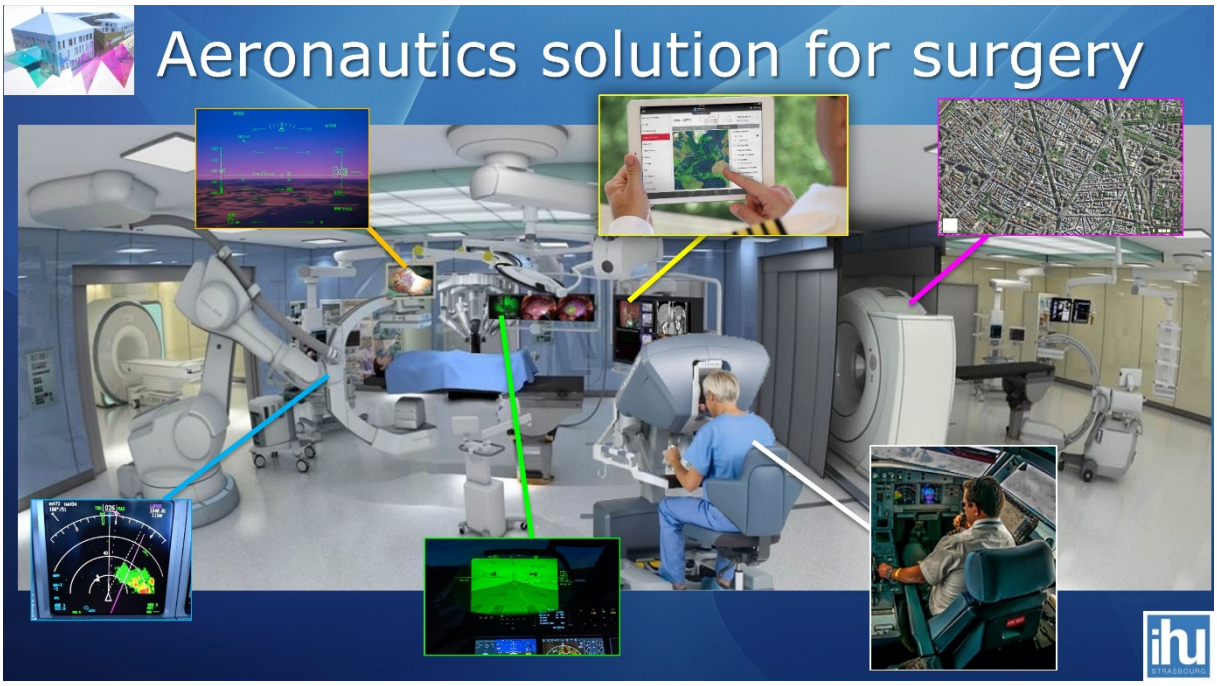


Augmented surgical vision is based on 3D/4D patient-specific modelling. The first step consists in the 3D delineation of organs and pathologies from a patient's medical image (CT or MRI). Such delineation is provided online to the surgeon thanks to the Visible Patient Service. This delineation is then used to realize a 3D model, which is a kind of virtual clone of the patient. Preoperatively, this clone can be used to plan the surgical procedure in the most efficient way thanks to user-friendly Virtual Surgical Planning software working on smartphone, tablet or personal computer. This virtual preoperative simulation allows for the definition of the most efficient therapy to be applied thanks to a perfect localisation of the pathology and surrounding vascularisation. Intraoperative assistance will then consist in superimposing this surgical planning onto the surgical view. This fusion between real vision and virtual model is called Augmented Reality and provides a kind of virtual transparency of the patient. Main limits of this technique are linked to organ movement and deformation between the preoperative image and the intraoperative position and shape. To overcome this limit, the introduction and use of 3D-medical imaging systems in the Operating Room is then mandatory. The resulting Hybrid OR is thus equipped with MRI, CT or/and 3D C-ARM such as the Artis Zeego from Siemens providing a 3D image of the patient after only 5 seconds of acquisition.



The 3D intraoperative medical image is then registered with the preoperative image in order to correct organ deformations. Thanks to the laparoscopic image analysis, it is possible for a computer to compute in real-time the precise location and shape of organs and pathology. This information can then be combined with a robotic system in order to develop the next generation of automated robots. Such improvement will be linked to Artificial Intelligence development based on deep learning. A.I. will then not only assists surgeon in the therapy definition, but also control and assist him intraoperatively as well as a pilot during a flight.

This new minimally invasive Image guided surgery is called Hybrid Surgery because it combines several technologies for a same objective and will be developed thanks to the development of Hybrid OP-Rooms such as the new OP-rooms installed at the Strasbourg IHU in 2016.



Scientific Director of IRCAD and Strasbourg IHU,
Strasbourg University Professor associated to the Endocrine & Digestive Surgical Team of Prof. Didier Mutter